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TRAINING TEACHERS FOR THE STUDY OF HOME GEOGRAPHY. A FIELD LESSON FOR A SUMMER INSTITUTE

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IT has long been conceded that the elementary ideas of geography must be gained first hand, through personal study of physical forces, land forms, and industrial activities. It is also generally recognized that mere passing notice, or observation that is unsystematic and without competent guidance, does not give that real insight into truths and their relations that shall serve as a clear basis for the imagination of forms and conditions elsewhere and for the interpretation of their meaning. Teachers read of the frequent outdoor lessons and occasional long tours common in the practice of German and Swiss schools, and heartily approve such methods. Nevertheless, if one ask almost any body of a hundred teachers how many have conducted field lessons within a year, the fingers of one hand will serve to count the number. Occasionally one hears of an elementary school where field study is practiced, yet even there it is usually found to be infrequent.

This divergence of theory and practice is in part due to the fact that the public often regards field lessons as picnics which the teacher and pupils take in place of real work. And the teacher may find

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them at first to be occasions for rather strenuous effort on her part to prevent a "picnic" for the pupils, who are alive to the novelty of the plan and naturally forget schoolroom restraints when the schoolroom is left. A more fundamental cause for slow advance in field work is that few teachers have been trained for it, and of these not all have gained such confidence as to be willing to do pioneer work while subject to suspicious criticism.

Under these conditions it is evidently the duty of all instructors of teachers to train them for this work in such wise as will ensure the adoption of class study in the field as one essential mode of teaching. Strangely enough, however, many higher schools have done little more than elementary schools, though perhaps for the same reasons. The study of home industries and economic conditions planned in the opening chapters of Clow's *Introduction to the Study of Commerce* is rather a novelty in text-books for secondary schools. Many teachers' institutes are held every summer, and geography always has an important place on their programs: yet the instruction usually consists wholly of indoor lectures. While these often suggest how easily a teacher *may* illustrate the forms and forces of nature by taking her children to the roadsides and home fields, there is a fatal failure to show in practice just how this should be done. Is this because the instructors shrink from the extra effort involved, or feel unable to readily plan a model lesson amid new surroundings? Or is it because the directors of institutes fail to plan for such instruction? It is also true that when field work is offered only a portion of a class of teachers care to make the physical effort and to meet the expense of joining field trips.

The value of field lessons and their rarity admitted, it is clearly incumbent on normal school principals and institute directors to see that adequate training for such service is provided. It is also the duty of superintendents to encourage a wise entrance upon such work by their teachers, and to plan and direct the first attempts. Were these two measures the rule now, superintendents would seek teachers with a measure of preparation for field work: there would exist both a demand and the means of supplying it. For ten years advance has been individual: the next decade should see the practice of class work in direct contact with nature and life become the general custom; for the method will have its full value only when systematically employed throughout the school course.

I recall field lessons with Professor W. M. Davis in the geography courses of the Harvard Summer School, and the regular afternoon excursions at the Cornell summer course in nature study, under Professor Bailey, Professor Roberts and Mrs. Comstock, as both most enjoyable and helpful portions of my own experience as a pupil in summer schools. I can testify from an experience as teacher and principal in elementary schools, and as instructor in summer institutes, that no lessons indoors require so much preparation, use so much physical and mental effort, or give such satisfactory returns as those out of sight of the schoolhouse. A type of such lessons is afforded by a Saturday afternoon excursion taken by some forty members of the New Hampshire Summer School of 1901 over the country between Plymouth and Hebron; and an account of the trip in detail will be suggestive of possibilities elsewhere. The excursion was repeated in 1902 by a party of more than eighty teachers.

It was necessary for the instructor to go slowly over the country the previous day, selecting the best route, noting the forms presented, determining their influence, and planning the succession of lessons to be taken with the class. The students were packed into two large mountain wagons and several smaller carriages, so the instructor found it more convenient to use a bicycle. Riding in advance, when the point for the first lesson was reached those in several wagons could be taught, then those in succeeding groups. The procession having passed, the bicycle bore the instructor again to the front, when the process was repeated at the next halting place.

The first problems concerned the formation and erosion of flood-plains and their life relations. By the roadside a recent summer shower had filled the gutters with a gently sloping plain of fine sand, over which could be traced the interlacing channels of streamlets. It was easy to read the story of waste swept from the stony hillside gutter, then deposited where the slope became gentle, filling the channel. Closer inspection showed where the streamlets had built up their beds, had overflowed and formed dividing courses on the sand, to reunite below. This roadside type was then related to similar forms on a large scale, such as the flood plain and many channels of the Platte and other rivers flowing eastward from the Rocky Mountains through valleys sunk in the plains.

At the top of the hill above Plymouth, one overlooked the Pemi-

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gewassett and Baker's River valleys. The hill and mountain slopes descended sharply at many points, in marked contrast to the levels of the valley floors. Two periods were evidently represented; one when the rather narrow valleys were eroded by the rivers, the second when the present sandy plains were deposited. Pictures of overloaded glacial streams of the present were recalled, and the story told of conditions in New England at the close of the last glacial epoch, when the streams were so weighted with waste from the melting ice and from the bare hill slopes that the valleys were deeply filled with gravel and sand.

At the foot of the hill the flood plain level was reached, and here a halt was made where the road crossed a deep gully by an embankment. It was quite as evident that a brook had formed this steep-sided little valley within recent years as that the gullies of the roadbed had been carved in recent days by rills of rain water. The hills are now forested, little waste is poured into the streams; the main river and its tributaries are removing the sand of their beds and are therefore cutting valleys in the flood plain. The gully was a type of a young valley, and one could see illustrations of stages in the formation of tributary valleys, which are working back into the plain wherever stream wash has undermined the sod of the bank.

Somewhat farther on, the road crossed a larger tributary, which wound in curves and oxbows toward the main river. The class noted the erosion of the outer bank at every curve, the tendency to lengthen the river course by forming oxbows, and again to shorten it by cutting across their necks. Nearby, on the main river, was a large oxbow, whose neck was nearly cut across, obliging the owner of the land to protect it from further erosion by many loads of stone. This suggested the costly works constructed by the national government to control the Mississippi.

From present action attention was drawn to past forms. Near one of the frequent curving banks was a crescent lakelet, half choked with lily pads and reeds, while depressions that continued its two horns toward the river revealed an abandoned oxbow channel. Above the low meadows two or more higher levels were noted, the upper bordering the valley side as a nearly continuous terrace of changing width, while the intermediate shelves were separate tracts of varying extent. These several terraces were limited by banks nearly as steep as those of the present river course; and the

depressions on the second level, at the foot of the rise to the upper terrace, were evidently old river channels formed when much less erosion had been accomplished. Thus the various forms were studied in turn so that they told their own story to the class, and the features of this sandy flood plain in its old age stood out clearly in their natural relations. This prepared for the consideration of local industries and life facts as related to the physiography, when a final stop was made beside a group of farm houses.

The fine soil of these intervales is fairly fertile, and being free from rocks and of level surface is much more easily cultivated than the boulder clay on the steep irregular hill slopes. The valley levels give easy grades to both roads and railroads, so communication is favored. As a result, creameries are located near the railroad stations, and the valley farms find a convenient market for their milk. Hay is cured from the grasses of the flood plains, fodder crops and vegetables are grown here and there on the terraces, and pastures extend from the upper terrace up the valley sides, penetrating the woodlands that possess the steeper slopes and most broken surface. The farm houses are naturally placed on the upper terrace where they are safe from the occasional spring floods; and the highway follows the natural roadbed of the upper terrace when possible. Thus the homes are conveniently situated between gardens and meadows on one side, and the pastures, sugar orchards and woodlands on the other. At intervals of some miles the terraced flood plain extends up tributary valleys, and the centering of roads at such points has favored placing stores, schools, and churches there, and so has determined the location of the occasional little villages. These are built on broad areas of the upper terrace, like the farm houses.

This story of terrace formation and its effect on local life could be duplicated many times over throughout northern New England, so it was of special value as being for many teachers a type of their own districts.

The course of the excursion was now southward, along a tributary valley and over the divide to the basin of Newfound Lake. A mile from Baker's River the road rose over a broad moraine that lay athwart the valley. Its hummocky surface and stony soil had so discouraged cultivation that nature was reclaiming its neglected pastures to woodland. The irregular surface, with frequent kettle holes, was strikingly unlike the plain just traversed; and its waste

appearance in clear contrast to the open farm lands below. South of the moraine was another nearly level valley tract, but above the terrace level. Once the glacier must have dammed this valley, since its slope is northward, forming a lake, whose floor was then built up by sediments, forming the present lake plain. Here again there were prosperous farms. This local example of the distribution of life and industry as determined by land form and soil suggested important world examples, for instance the Highlands and the Lowland Plain of Scotland.

The road soon rose steeply toward the divide, birch and beech mingled their music overhead, welcome springs of cold water trickled from the mossy banks, while almost the only trace of man outside the road was an old sugar camp at the summit of the pass. The road existed only to connect neighboring valley settlements, no one lived midway its course; it was of the same class as the roads over the Alps and the tunnels through them. The difficulty of transportation over the divide explained the fact that local interests on either side the pass lay in opposite directions, to one side toward Plymouth, while on the southern slope life, like the water, was drawn toward distant Bristol at the foot of Newfound Lake. In similar fashion mountain barriers divide races and nations, while roads over the passes give a measure of communication. On the day of our trip the battle was not between opposing armies, as of yore, but between rival baseball teams, one having crossed the divide from Plymouth to contest with its natural rivals on the other slope. Tracing out the home dependence of life on land form will deepen interest in far reaching influences elsewhere and enable their clear apprehension.

A half mile from the summit of the pass a fine terminal moraine, in the form of an esker-like ridge, swings across the valley in two curves. At its lowest point, it is breached by a brook valley, which affords way, also, for a road to farms beyond. The class here left the carriages and climbed the bowlder strewn ridge to its highest point, where debris had evidently accumulated from ice lobes terminating at either hand. The knoll thus fell into the same class as Manomet Hill, the landmark of the Pilgrims in making Plymouth Harbor. The steep north face of the moraine, which once lay against the glacier front, was compared with the somewhat gentler southern slope; and with the aid of pictures of present glacial scenes the conditions existing when the moraine was formed were imagined.

At our feet a little valley, filled with boulders, had evidently been worn across the moraine in the long past. Though now grass-grown, it was not difficult to repicture the waters dashing among the stones along its course. Turning toward their source, the valley ended in air, marvellously, cleanly severed by the northern ice-face of the moraine. Evidently the valley had once been continued upon or into the ice of the glacier, which had long since melted away. Tracing the story of the little valley, which now was of use only to furnish greener grass for sheep to nibble, and an easy path across the ridge, an illustration was afforded of how geographers interpret—in varied ways—the past of larger valleys that exert potent influences on human industry.

Seated on the sterile moraine, that grew but lichens and wiry grasses, the eye rested with delight on a beautiful expanse of level meadow lands and cultivated fields, crossed picturesquely by alder-bordered brooks, which were lost to the eye where woodlands marked the rugged land of yet another terminal moraine. Presumably the meadow was the result of deposition of rock waste from the melting glacier in a temporary lake behind the earlier moraine. The ridge itself was but pasture land for sheep; the narrow fields up the valley were occupied by farms whose dwellings indicated but small returns for labor; but the broad and fertile acres to the south were overlooked by two finely kept groups of farm buildings under shelter of the moraine ridge. Here the silt of the old lake bottom gave such generous returns that to comfort was added beauty; for instance, a fine double row of maples lined the roadway, an evidence of prosperity and breadth of interests.

The lesson was typical of the study of the smaller land forms in a school district with a view to discovering their relation to the life of the community. It also suggested many cases of the control of life by environment throughout the world—the development of civilization and its arts amid the prosperity natural to the oriental valley plains on the border of the tropics—the wealthy farms of the lake plains about the Red River in Dakota and Minnesota.

Other minor lessons were interspersed here and there. For instance a halt was called where the road crossed a long glaciated granite outcrop, whose curving surface yet preserved the parallel grooves and striations left by the glacial rasp. Enough had been seen to give a conception of glacial work in erosion and deposition, the formation of soil, and its assortment by water so as to give

unlike conditions in neighboring fields, explaining the contrasts often afforded by adjoining farms. Incidentally, too, there had been opportunity to call attention to the plant societies of forest, field, and meadow, and phases of insect life noted in passing.

The last problem of the afternoon was to trace the life history and the present values of a series of delta formations in Hebron. From a hill we overlooked a stream, which flowed across half overflowed meadows and entered Newfound Lake through several distributaries that had thrust forward fingers of river deposits. Here was a miniature model of the Mississippi delta. Beyond was a high level plain, between the walls of the valley sides, that extended down from the distance to an abrupt termination above the marshes of the inlet. The class had the general plan in mind, and were ready to study details with appreciation.

Passing down the hill, several examples of deltas were noted in the gutters, with their nearly level surfaces and with marked front slopes where the sands pushed along by the rills had rolled down into deeper water. The road passed one or two minor brook channels of the meadow lands, evidently active in time of high water, then crossed the main stream by an iron bridge. There were high, firm banks, a rod or two wide, along the stream, dividing it from the stagnant water of the reedy marshes. At one point débris was stranded that had been washed over the banks when the stream spread out in spring floods. Evidently it had been left there because the current on the banks had been too gentle to sweep it further along, and manifestly these natural levees were thus formed in the slackening current of overflows. Just here the Donaldsonville sheet, of the United States Geological Survey maps, came into play; and the local type, in connection with the map, explained the conditions that exist from Cairo to the Gulf. Before us the firm banks allowed the fisherman to walk dry shod, and a farm wagon might pass that would have mired in attempting to cross the marsh. Similarly the natural levee of the Mississippi, two miles broad, affords way for railroads and highways; the dwellings and villages are along the river bank, and the farms and fields on the lower portions of the natural levees, away from the river.

Another halt was made at the front of the upper sand plain, much of which the river had carried away as it swung over it in curving channels during past years, leaving terraces and moats like those studied along Baker's River. It was evident that this plain

also had been deposited by an overloaded stream, which was now able to again take up its load and carry it on. But why the rather steep and very abrupt front, to which the class walked? At one point an old oxbow of the river had swung in against the front, leaving a yet steeper descent, thus proving the prevailing front slope due to another cause. The recently studied gutter deltas were recalled, and it was perceived that if the water had stood twenty feet higher in the lake when the upper plain was forming, just the present form must have resulted, as a delta was built forward in this arm of the lake. Were the lake waters to be then lowered, perhaps by erosion of a gravel dam at the outlet, the delta would be itself exposed to such erosion as had here taken place, and abundant material afforded for building the later delta at the new water level. The half drowned top of this new delta was the result of raising the lake waters several feet by a dam constructed at the outlet a half century ago.

A few rods more and our party drove across the "common" of Hebron, a typical village green, with church, school, town house, general store, and trim white dwellings with their green blinds. On all sides were mountain slopes and narrow valleys; here met the roadways along the lake and roads from several centering valleys. This broad delta plain, with the fertile lower terraces of the stream, was the natural site for a village. For the children in the little school, it is as important to know the story of their home lands and the physical conditions that determined the location of their village, as to know the causes influencing the location and growth of Chicago or New York. For them, more important, for this problem deals with what they may see and apprehend; it will make intelligible the larger problems of the unseen world, and will also form a foundation for an intelligent consideration and advancement of local interests in later life.

The homeward journey gave the measure of beauty and enjoyment of "Nature for her own sake" that may well form part of every field trip. A little steamer bore the party far out on the lake, beneath forbidding precipices that overlook the flooded depths of the valley, then across to gentler slopes lit up by late afternoon sunshine and marked at points by summer homes or isolated farmsteads. The return drive lay over a lonely hill road, with steep grades rising from shady glades to hill crests whence one looked away to glorious sunset clouds floating above the western valleys

and mountains. We appreciated both the attraction of the hillside homes for summer guests and their lack of fitness for those who would keep in social and economic touch with the world throughout the year.

This long trip was supplemented both by brief excursions in the neighborhood of Plymouth, and by the discussion in the classroom of the best ways and means of preparing, conducting and utilizing field trips in their relation to the school room work with maps and texts. Space forbids considering the work further, and the author has already in the *Journal of School Geography* (Vol. 3, p. 287) related his experience and conclusions. In normal schools and summer institutes there should be frequent trips for the study of local forms, to discover their causes and life effects by investigation in the field. These will tend to prepare the teacher for the ready use of advanced and scientific texts as guides, and to give her courage to attempt the interpretation of the geography of her own school district.

THE INFLUENCE OF PONDS AND RIVERS ON ATMOSPHERIC TEMPERATURES

BY M. S. W. JEFFERSON, PROFESSOR OF GEOGRAPHY, STATE NORMAL SCHOOL, YPSILANTI, MICHIGAN.

MR. Abbott's interesting paper "Observations on the Temperature of Spring Water," in the *Journal of School Geography*, April, 1901, has led the writer to see what interest he could find in the temperature of water bodies in his neighborhood, with a view to their use in teaching. Salisbury Lake, in Brockton, Mass., is a small sheet of water barely four feet deep, yet it was found to exercise sufficient influence on the temperature of the neighboring air to give a good illustration of the moderating influence of the ocean on temperatures over neighboring coasts. This was, of course, most pronounced on occasions of a strong change of temperature, when the water showed a considerable lagging behind the air in its changes.

On a hot spring day after a cool spell, two boys were sent from a class that recited from 12 to 1, with instructions to measure air temperatures at the school near the pond, over the center of the pond, and then measure the temperature of the water. They were boys who had had some previous training in reading thermometers. They found the air near the pond two degrees cooler than elsewhere, the air out over the pond four degrees cooler, and the water six or seven degrees cooler. Their being sent from the class with complete instructions as to what to do, though without intimation of what result was to be expected, and their return near the end of the hour to their envying and curious comrades, may have helped to impress the result on the memory of the class. Similarly, observations made by the same boys on a cold night after some warm days showed the air above the lake several degrees warmer than other air, while the water was yet warmer. There is, of course, nothing surprising about the result except the small size of the lake. I am inclined to think no pool of water is too insignificant to be worth investigation with regard to its temperatures, especially after a sudden rise or fall of the thermometer.

Wells, being completely protected from the sun, will give very interesting results, which are peculiarly available when they are fitted with pumps; the water has only to be pumped upon the thermometer until a constant temperature is reached when the reading may be made. Results not unlike those obtained by Mr. Abbott's class from their spring may be obtained in this way wherever there is access to a well with pump. Such observations give not merely a useful illustration of the superficial character of our temperature changes but serve as a concrete step towards reports of temperatures obtained from deep wells with discussion of their significance.

I have not at hand here the figures obtained in these Salisbury Lake observations. The annexed diagrams, however, embody certain observations to which these led me. In the Brockton High School yard is a small river with meander bluffs, sand banks and bridge. I have been in the habit of utilizing it for geographic illustration and added temperature studies to its considerable list of educational utilities. The stream is small and in this case air temperatures were only rarely influenced to a perceptible degree. The evenness of the water temperature, however, compared with that of the air is valuable for objective teaching in preparation for the

idea of even oceanic climates. A longer series of observations was undertaken on the Matfield River, near my house at Elmswood, Mass., in connection with other studies that require recurrent visits to the riverside. Two weeks' record of these observations appear on the diagrams. The stream is a small one, with a width of thirty feet and a depth of about two, and delivers about sixty cubic feet

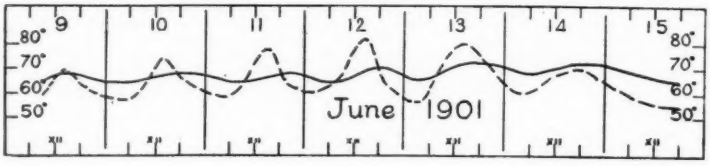

FIG. 1.

of water per second for the average of the year. Readings were made as near maxima and minima as possible. June 9, 14 and 15 were cloudy days, the others clear, as might be inferred from the diurnal rise and fall of the dotted line indicating air temperatures; while the solid line representing water temperatures was little influenced by sun or cloud.

The extraordinary drop of 27° in the May record occurred in a few minutes, while I happened to be sitting on my lawn with a thermometer in my hand, having just come from reading temperatures at the river. It had the effect of making the river, which

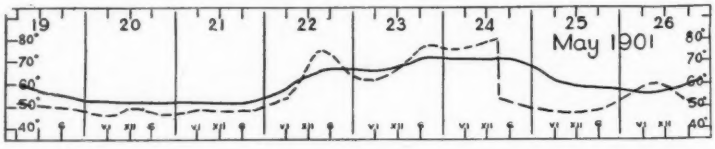

FIG. 2.

had felt cool to the hand, feel distinctly warm, while its temperature was really almost unchanged. On this diagram again the 19th, 20th, 21st and 25th were cloudy.

Though so long a series of observations as that from which these are selections would involve much trouble and can hardly be made by the school, results so striking make me think that the teachers of physical geography can well afford to study the waters in their neighborhood.

FLOOD STUDIES ON MATFIELD RIVER*

BY M. S. W. JEFFERSON, PROFESSOR OF GEOGRAPHY, STATE NORMAL SCHOOL, YPSILANTI, MICH.

RAIN falling on the surface of the earth runs off, in part over the surface, causing the streams to swell and overflow their banks; in part soaks rapidly through the ground, under pressure, perhaps, from superadjacent water; and in part seeps or drains out slowly, maintaining the flow of streams in dry weather. In the course of six months' gauging on the Matfield river, near Elmwood, Mass., I have noted some details concerning the relations between these various forms of run-off that are not without geographic interest. Especially worth noting is the great accession of flood waters immediately after the rain has ceased falling. As some of the details may be peculiar and local I give below a brief account of the main features of the basin.

The Matfield is a small river, here about thirty feet wide and two deep, delivering approximately sixty cubic feet of water per second. For about a mile near Elmwood it flows in a valley six hundred feet wide, floored with a flood plain that is fairly under water at the five-foot stage of the gauge. This plain is bounded by bluffs varying from twenty to thiry feet in height. The area of the basin above the gauge is about forty square miles, and there are few points distant so much as a mile and a half from the river or main tributary. The bluffs are grassed over save in a few sites

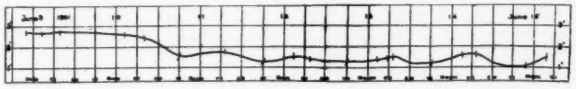

FIG. 1.

of frequent landslips, but these occupy an insignificant percentage of the whole area. At the foot of the bluffs numerous springs emerge, which swell rapidly during rains and neighboring swamps feed not a few tributary brooks.

* The first paper in this series was published in the JOURNAL OF SCHOOL GEOGRAPHY, June, 1901, p. 238.

The stream is dammed for water power at two points above Elmwood, and the daily flow and nightly storage appears very distinctly at low stages, as will be seen in the diagram of gauge readings for June 9 to 15 (Fig. 1).

The gauge employed was a clapboard with feet and inches painted on it. This was nailed to a post under an old mill near Elmwood Bridge.

Mean water is probably not far from the two-foot mark on the gauge, while at five feet, as has been said, the river leaves its bed and occupies most of the flood plain, the last portions to disappear beneath the water being the narrow strip of natural levee on either margin of the river bed.

The diagrams are almost self-explanatory, carrying height of water on the horizontal lines with numbers right and left, while the verticals give the time in six hour sub-divisions with dates at the top. The heavy curve represents the varying stand of the river surface with short cross-lines to indicate the times of observation that the reader may judge of the personal element present in drawing the curve.

During the week referred to no rain fell and the sky was clear. The water had been falling steadily ever since the heavy rains of late May, checked by a night rain June 7. On the 11th begins the series of daily oscillations that I suppose are due to the daily flow of water through the mill sluices with a somewhat abrupt fall at evening when the sluices are closed for night storage. This recurs at low stages as long as the mills are able to use the water at all. It seems to have no influence on the flood stages shown in other diagrams.

The chief features of flood rise and fall are well marked on the diagrams for May 18–22 and March 21–28, which have been selected as typical. For an hour or so after it begins to rain there is an

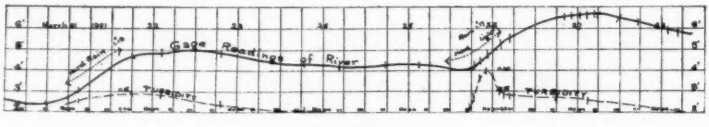

FIG. 2.

abrupt rise in the river, continuing, but less abruptly, until a maximum is reached about twenty-four hours after the rain has ceased (Fig. 2). The times of beginning and end of rain are marked

on the diagrams by arrowheads terminating the dotted lines to right and left.

The turbidity represented at the bottom of the diagrams is determined by measuring the depth at which a wire placed horizontal in the water becomes invisible, as suggested in *Irrigation Paper No. 35, of the U. S. Geological Survey*, p. 25, and the scale is that there adopted. As I used copper wire instead of platinum, my observations have no exact relation to that scale, but they plainly have a value among themselves. No such observations of turbidity are capable of much accuracy since the amount and direction of the light constantly vary. Yet the use here made of the measurements is well within their limit of value.

Now these turbidity readings indicate that the water begins to get muddy soon after the beginning of the rain or soon after it begins to rain hard; but unlike the height of water a maximum is reached at the end of the heaviest rain (Fig. 3).

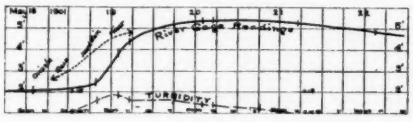

FIG. 3.

I have studied the matter on the spot with some care during and after storms, and suggest the following explanation:

The fall of a hard rain soon makes the street gutters run thick from plowed land and bare roadway surfaces. This soon discolors the surfaces of the river. As the rain diminishes in intensity, the gutter streams rapidly dwindle and presently cease to flow, or carry only a trickle of slow clear water. But the ground is everywhere saturated with water, and its weight forces out the water from the lower layers of ground beside the streams. This occurring over the whole basin maintains the volume poured into the river at a sufficient quantity to increase its rise for many hours more.

The time of this delay of maximum rise after the close of a shower must vary chiefly with the area and topography of the stream basin, though the manner in which the rain falls cannot be without influence. The water of this after-storm rise is progressively clearer and clearer as it comes to the river through the ground with a speed that diminishes as the weight of the water above it lessens, while the muddy water that was still running toward the river in longer brooks

when the rain ceased soon arrives with its burden and ceases to discolor the filtered ground water that continues to rise.

It is altogether probable that the observations of turbidity May 19 and March 21 were not made at the time of maximum.

On beginning this series of observations I had hoped to obtain some curves of storm rise in summer and winter with comparable amounts of rain. Although my departure from Elmwood has prevented the conclusion of the evidence, this much may be said: the Matfield, like most New England streams, is in flood in the spring. That the cause is not heavy spring rains appears from the records of the Weather Bureau (*Ann. Rept.*, 1896–97, p. 358), which when analyzed give New England the following seasonal rainfall:

December to February	10″
March to May	10.2
June to August	11.1
September to November	10.8

The spring rains are therefore rather light than heavy. Nor is it wholly due to the ground being in early spring impervious with frost, though this doubtless contributes. Thus the highest stage observed in my series was 6 feet 9 inches on March 11, when there was doubtless frost in the ground. It corresponded to a rainfall of 1.86 inches, but the two rains of March 21 and 26, summing 2.3 inches, produced nearly as great a result after the frost was gone. Equally heavy rains in summer or early fall of the last two years certainly have not lifted the water to the five-foot level since that would have resulted in flooded meadows. I believe that still more important than frost in the ground is the filling of the pores of the ground with water in the spring rains, when evaporation is moderate and the abstraction of water by plant growth has not yet begun. The quantity of water that can be stored in the soil is very great. This is evident on considering the amount yielded up to the rivers, maintaining their flow between rains. If the pores of the soil in which rain falls be empty a considerable downpour may find immediate storage in the ground and produce little effect on the streams. And during fall and summer the two forms of evaporation are so active that an empty condition of the soil interstices must often be approached. Measures of evaporation from the ground are not satisfactory, but the amount is certainly larger in hot weather. According to the *1894 Year Book of the Department of Agriculture*,

p. 174, a crop of hay in growing abstracts from the ground more than the equivalent of five inches of rain, or nearly half of all that falls in the growing season. L. H. Bailey, in his "Botany," p. 82, puts an estimate on the amount of water that needs to pass through each ounce of dried vegetable matter during its period of growth, which implies from eight to twenty inches of rain thus used. I believe these two drains on the soil in summer cause the absence of summer floods.

One of the most carefully studied basins in New England is that of Lake Cochichuate, *Irrigation Paper* No. 35, p. 38. From 36 years of observation it appears that the run-off in the streams is 26.72 inches less than the rainfall in the whole year, because of various forms of evaporation; and eleven inches, or 41 per cent. of all of it occurs in the less than four months of summer growth.

IRRIGATION METHODS *

BY GEORGE B. HOLLISTER, RESIDENT HYDROGRAPHER, U. S. G. S., RUTHERFORD, N. J.

IRRIGATION, which is yearly becoming a more important factor in the industrial development of the country, presents many interesting features in its practical application. The intelligent dweller in the humid regions, who has not had the advantage of travel into the arid sections of the country, knows in a general way what irrigation is and comprehends its broader results. But few, perhaps, understand the actual processes by which a desert and almost worthless tract of land is reclaimed by the application of water and in a few seasons covered with a growth of luxuriant vegetation and made to yield not one, but several crops a year. Yet this process has been going on for fifty years or more in the western part of our country, until, as we find by the official figures in 1900, 7,500,000 acres had been thus brought under cultivation. It would be interesting to compare the statistics further and discover what this vast acreage means in increase of land values and taxable property, in the production of valuable commodities, in growing population, in sociological and political influence, and in

* Illustrations by courtesy of the U. S. Geological Survey.

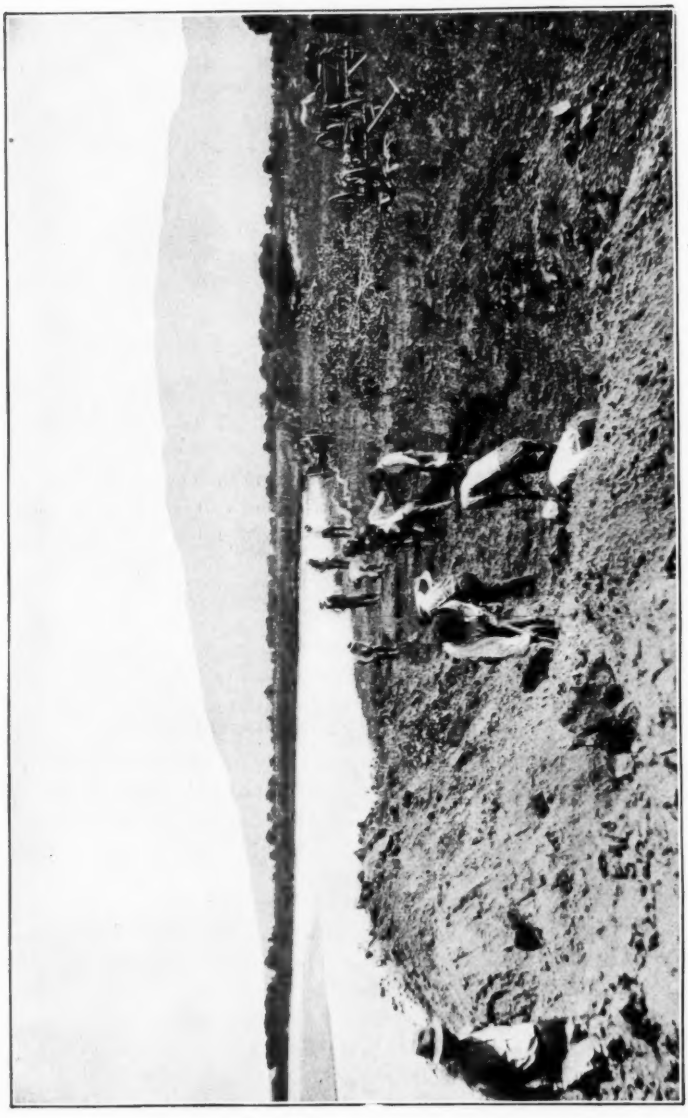

FIG. 1. EXCAVATING FOR THE HEAD OF AN IRRIGATION CANAL.

all those lines of development which make for a nation's progress, but this would occupy very much more space than is at our disposal and we will confine ourselves to a few of the simple methods by which the reclamation of the land is accomplished.

Of course, irrigation methods differ greatly with local environment, but one fundamental condition must always be present, viz., the proximity of water to arable land, in other words the land which is to be irrigated must be located near enough to a constantly flowing stream that the engineering cost of bringing water to it will be sufficiently low to leave a fair margin of profit from the proceeds of the crops; hence, it will be seen that some of the land in the west, even though fertile in itself, can never be profitably irrigated because the expense of delivering water to it would be greater than the value of the produce raised upon it.

The early irrigators selected lands in broad and fertile river bottoms, and by digging trenches at points short distances up stream led off enough water for their uses at comparatively small expense. Fig. 1 represents such a canal in the course of construction where the tapping of the river was not a difficult or expensive matter. At or a short distance below the inlet from the river, locks or gates are built across the canal for the purpose of regulating the flow through it and cutting it off entirely when not needed.

But water for irrigation is by no means always easily secured; often it must be brought from long distances and through mountain gorges as in sections of California, Colorado and elsewhere, involving the construction of expensive flumes and even of tunneling through the mountain spurs. An idea of the labor and money involved in the construction of these canals is afforded by the accompanying views (Figs. 2 and 3) taken at different points on the system of canals which supply water for the Greeley district in the valley of Cache la Poudre Creek, Colorado. Some of these canals, cut from the solid rock, run for miles at high elevations on the mountain side, and some of them wind through canyons and across ravines extending their sinuous course from twenty-five to fifty miles before they reach the arable valleys where their water is to be used. One of them, the Larimer and Weld Canal, which is fifty miles in length, was built at a cost of $150,000. For many years the progress of irrigation has been stady and as the more available locations were appropriated it became necessary to con-

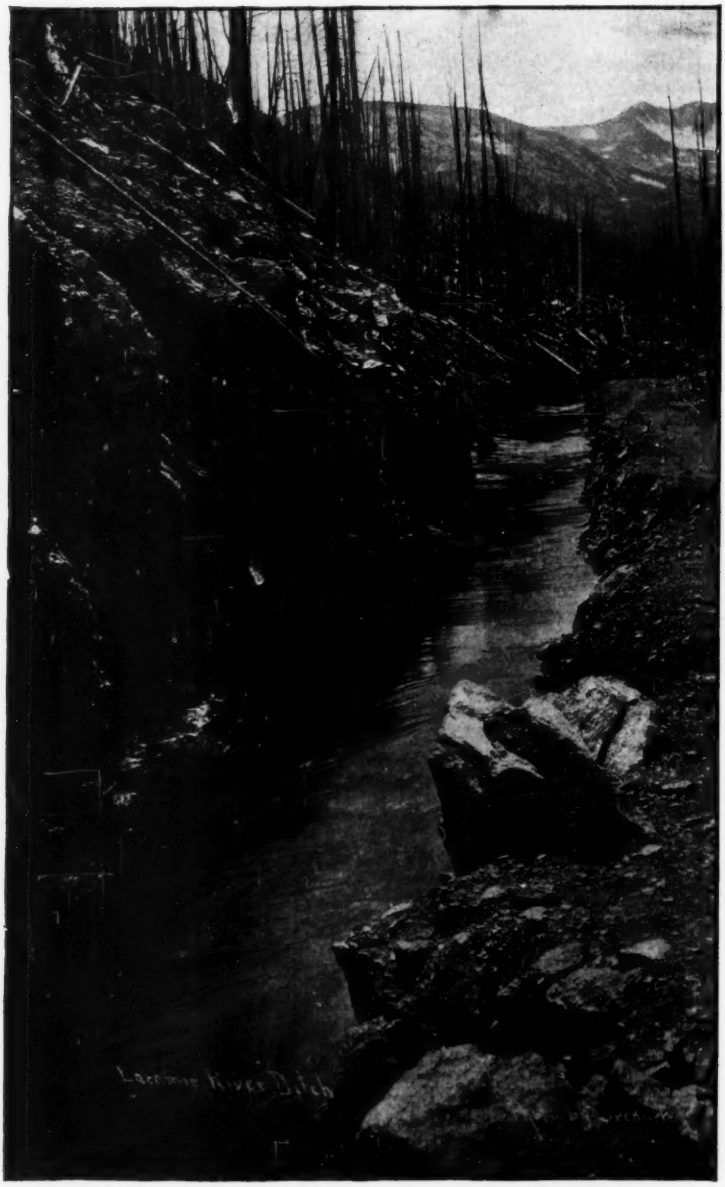

FIG. 2. SKY-LINE CANAL, NEAR GREELEY, COLORADO.

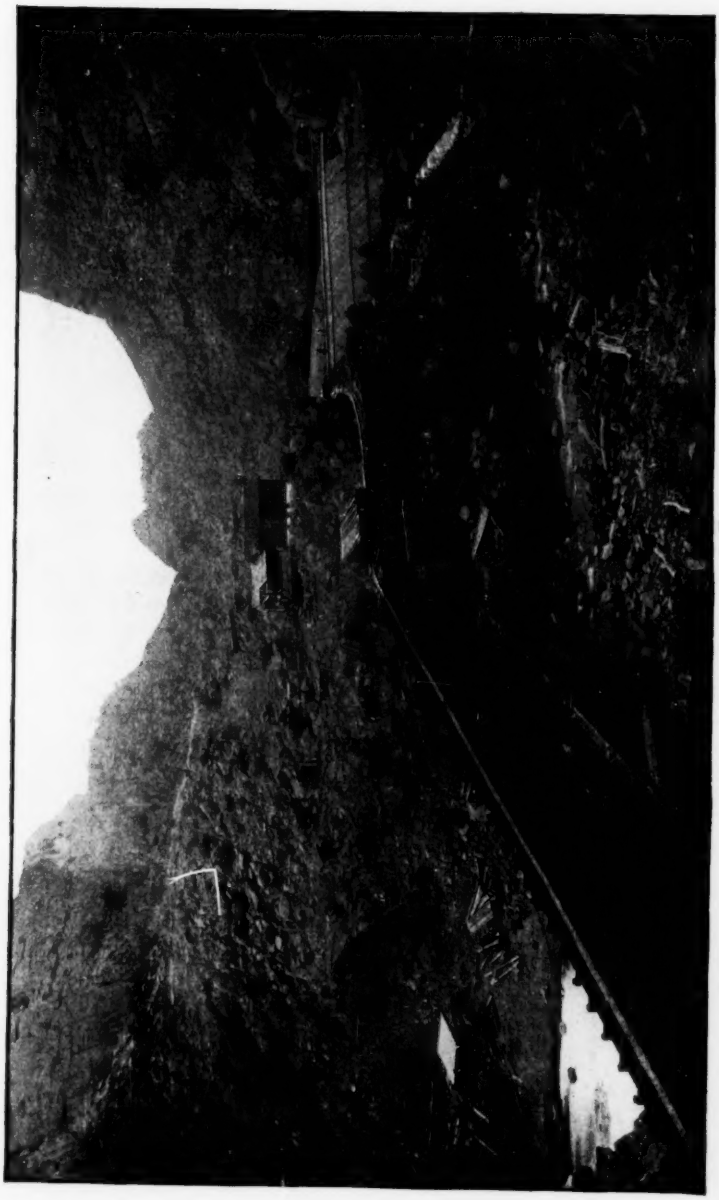

FIG. 3. DIVERSION DAM AND FLUME OF IRRIGATION CANAL NEAR GREELEY COLORADO.

duct water greater distances by more elaborate and expensive plans until, at the present time, practically all of the waters have been taken that can be had at reasonable expense without some further conservation of the streams.

From all over the west there is coming the demand for the construction of immense storage reservoirs to impound and hold for use in the summer months, the flood waters which now go to waste during the spring time. This condition is an interesting and exceedingly important one and is the fundamental cause of the irrigation legislation which has been so earnestly advocated by all who desire the further extension of irrigation in the United States.

When the engineering problems of diverting and delivering the water are solved, only the first steps of the difficulties are overcome. Before the farmer can make use of the supply which the canal brings to his land, he must prepare the ground to receive it. This often requires considerable labor, for, to be of greatest benefit, the water must reach all parts of the fields equally, and, unless the surface is nearly level, skillful management is necessary to direct and control the flow. Occasionally when the land is very slightly and evenly graded ordinary furrows can be plowed from the neighborhood of the main ditch, which is always located at the upper part of the field, and the water allowed to flow through them across the slope. This is a simple and economical method of preparing the land, but such favorable conditions are not always to be found, and in many cases the surface will be broken by steeper slopes or a series of rises and depressions, the effect of which upon the flow requires some ingenuity to counteract. A number of methods for accomplishing this are used. The most commonly employed in New Mexico and the southwestern states and territories is known as flooding by checks. To prepare a field in this manner, the cultivator throws a series of low, broad dikes, or levees, across it and other dikes or checks, as they are locally called, at right angles to the first series, so that the field is divided into a number of rectangular sections from one to several rods on each side. The water is then allowed to run slowly into the series of rectangles which lie at the upper part of the field nearest the main ditch; the checks of this section hold it from washing down too rapidly and permit it to escape through openings in the embankments into the series next below, and so on until the entire

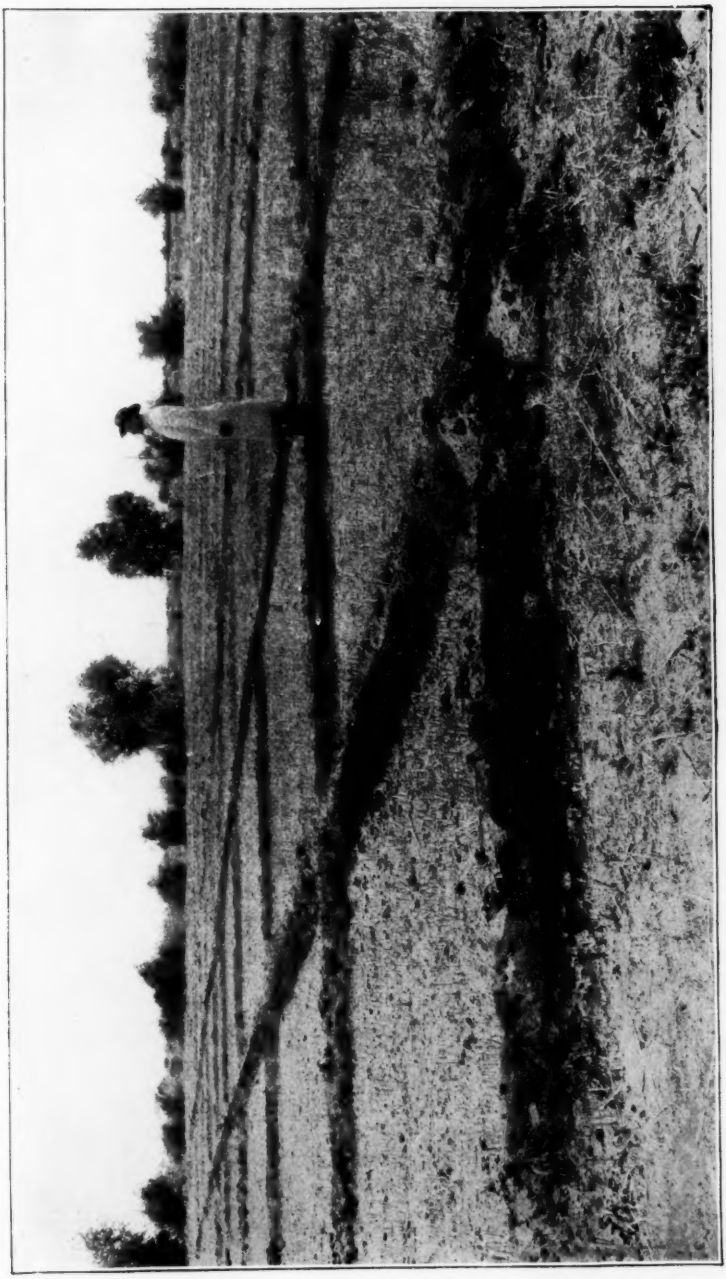

FIG. 4. FIELD PREPARED FOR IRRIGATION BY CHECKS.

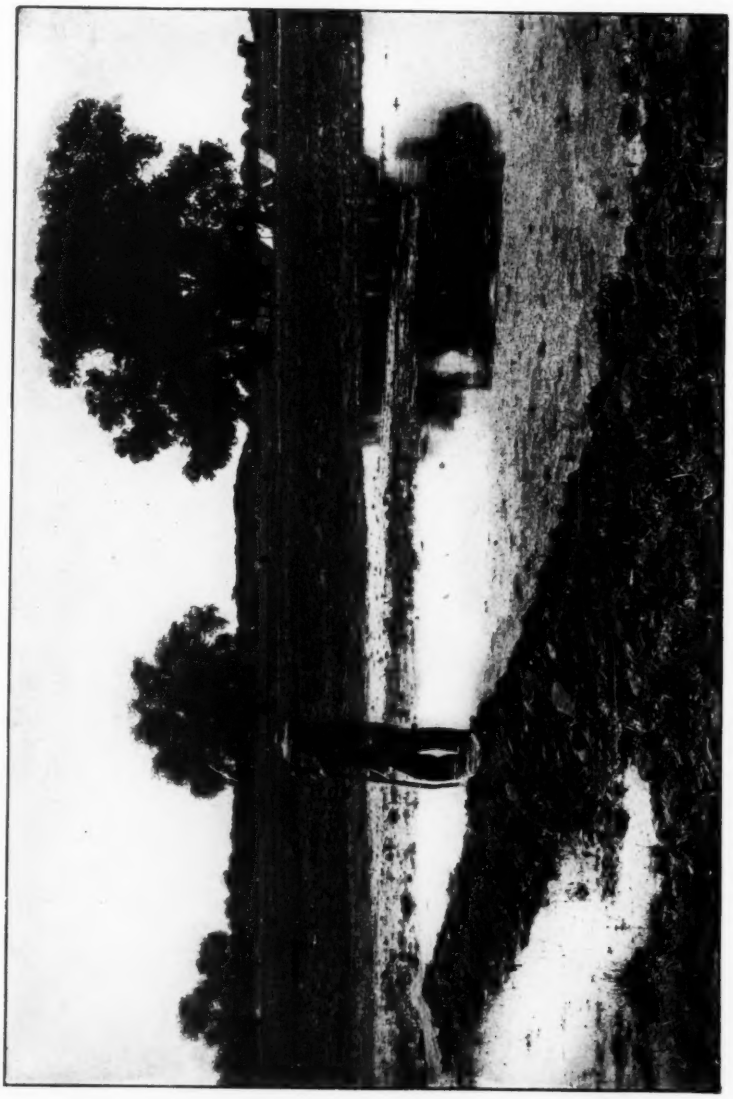

FIG. 5. WATER PASSING OVER A FIELD PREPARED BY CHECKS. SAN JOAQUIN VALLEY, CALIFORNIA.

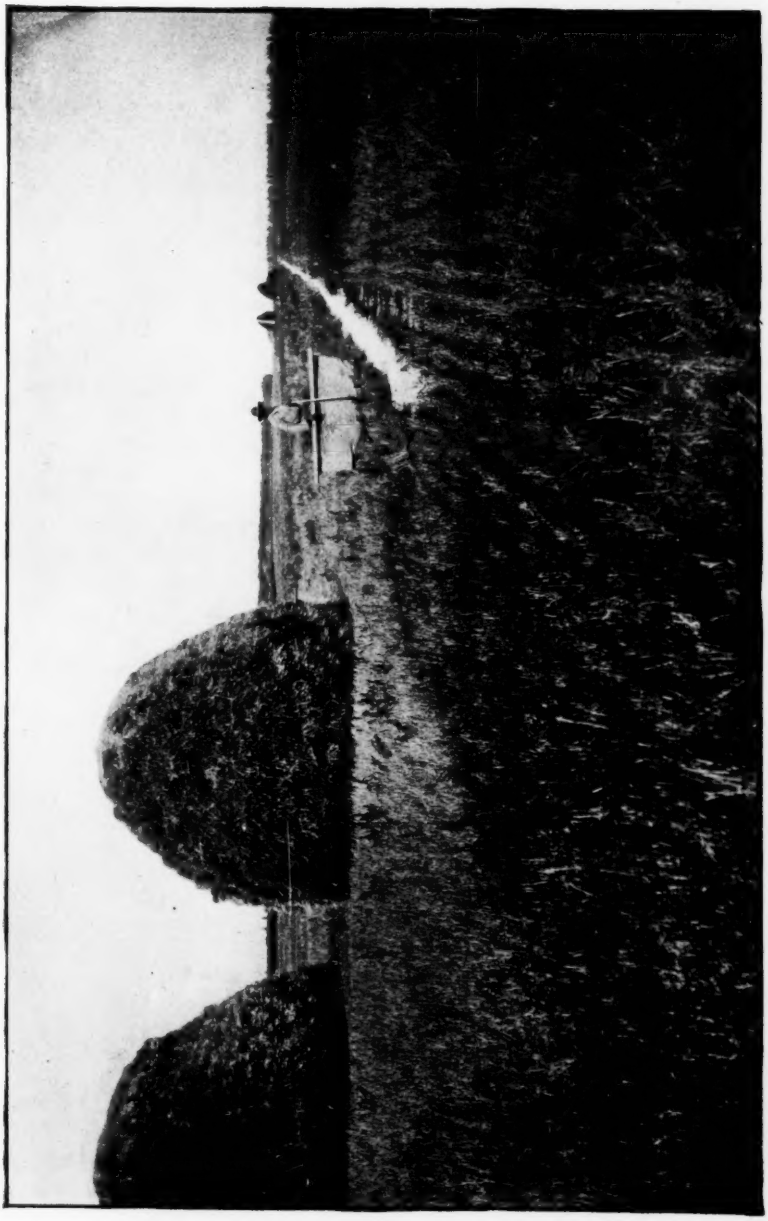

FIG 6. IRRIGATION ON THE GREAT PLAINS. CANVAS DAM ABOUT TO BE PLACED IN POSITION.

field is irrigated. Figs. 4 and 5 show a field prepared in this way and water in actual passage from a higher check to a lower An attendant stands ready with a hoe in hand at these openings to guide the water when necessary, though for successful irrigation it is not essential that the irrigator himself—in this particular case a Chinese hand—as shown in the picture, should be submerged. This method is practised largely by the Mexicans for their grain and other crops, but unless carefully managed it is apt to be wasteful of water. In passing it is interesting to note that as much harm can be done to growing crops by giving them too much water as by providing too little.

When the land is quite uneven still more elaborate preparations are necessary and ditches are dug to follow the contour lines of the surface; these are tapped at various points by yet smaller trenches and in this way the water is conducted to all portions of the land.

On the level farms of the Greeley section and elsewhere, a simple but effective method of flooding is used. The farmer has only to run a large double-mould-board plow drawn by four to six heavy horses, which penetrates the field to a depth of twelve inches, and, throwing a bank to each side, leaves a clean ditch behind it; these ditches are usually 100 feet apart. At suitable intervals a canvas dam is put into the ditch, the pole to which the edge of the canvas is nailed is supported on both banks; the cloth lies in the bottom and on the edges of the ditch and is kept down by a little dirt thrown upon it. Just above, the dam is cut on one or both sides and the water which is checked by it finds its way out through these openings into the fields. This process is repeated until all the land is irrigated. The process of flooding by canvas dams is graphically shown in the illustrations, Figs. 6 and 7; in this case the water is being run into an alfalfa field, the great forage crop of the west, for a second yield, and large stacks of the first crop are to be seen in the picture awaiting removal.

Sometimes water is taken from a main canal and allowed to run in furrows simply plowed in close parallel lines, and where the character of the ground will permit it, this is the best method of irrigating for corn, potatoes and other crops which grow in ridges.

Irrigation for fruit trees, vineyards and orchards differs somewhat from ordinary flooding. Here the trees or vines are set in

FIG. 7. IRRIGATING A WHEAT FIELD, THE CANVAS DAM IN PLACE.

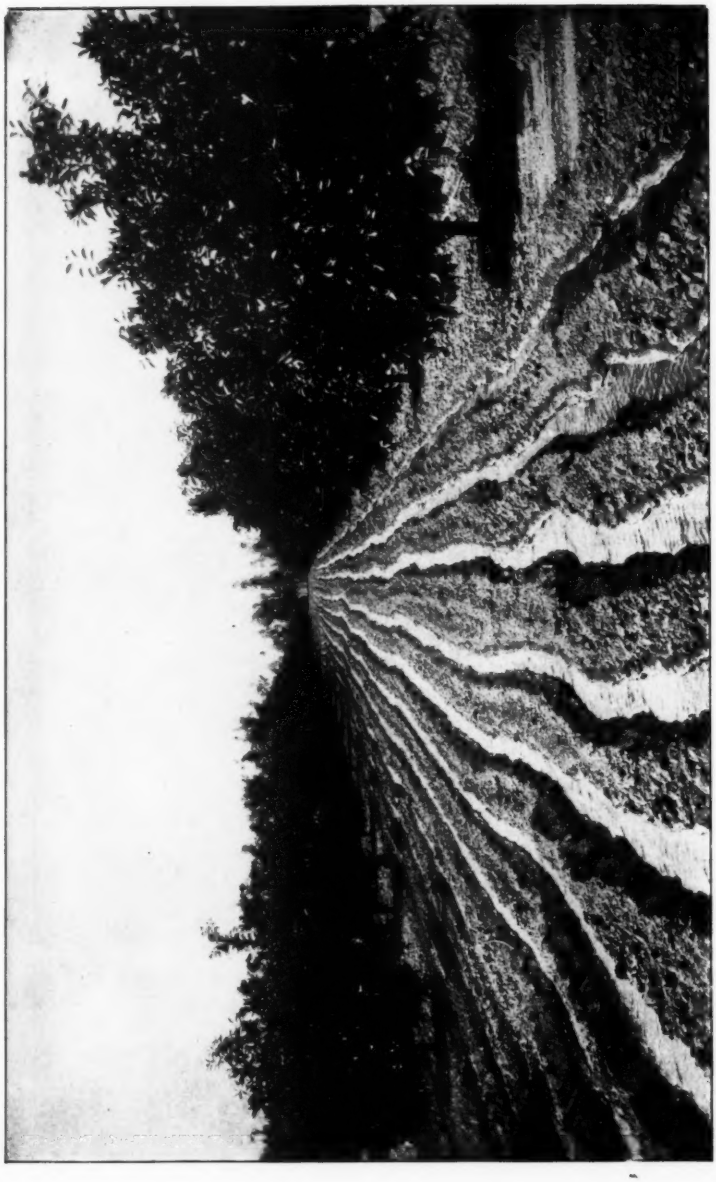

FIG. 8. ORCHARD IRRIGATION BY MEANS OF FURROWS.

rows and the water must be brought in small ditches which follow the rows and from which the roots can be easily reached. The accompanying view (Fig. 8) clearly illustrates the method of constructing the ditches and shows a thriving orchard which is growing luxuriantly on land which was before almost absolutely barren. While many crops thrive well and can be successfully grown under irrigation, fruits and the higher priced vegetables are more and more becoming the favorite crops on irrigated farms. This is chiefly because of their greater relative value; it takes less land and hence reduces the expense of the farm maintenance to raise oranges and lemons than corn or wheat, and the prices received for the former acre for acre are far in excess of those obtained from the latter, so that the tendency in the arid sections, especially where the climate is warm, is toward the development of small farms, more intensively worked with fruits as the main crops and the necessary vegetables, rather than the cultivation of large areas in grains or hay. This, as has frequently been pointed out, allows the members of the farming communities to enjoy the privileges of village or even town life with the advantages of social intercourse which is denied to the owners of large farms of the central and eastern parts of the country.

The field of irrigation in the United States is large, and, as has already been stated, the methods of its practice are numerous. Much information of interest and value may be had from some of the recent works on the subject and from reports and publication of the Division of Hydrography of the U. S. Geological Survey, whose studies of the country's water resources have given it an intimate and comprehensive view of the development and progress of irrigation in all parts of the arid regions.

XUM

GEOGRAPHY IN GERMANY. I. THE PRIMARY AND SECONDARY SCHOOLS

BY J. RUSSELL SMITH.

TO understand the status of geography in the German schools, one must have a clear view of the rather complicated system of which the various schools form parts. It is, however, impossible to generalize upon the school organization of Germany as a whole. There are too many independent state systems, each of which differs somewhat from all the others. The description below refers to the Kingdom of Saxony and to the City of Leipzig, and with the omission of names of schools it may be taken as one of the best types in both organization* and instruction in geography in Germany.

In the field of general culture there are four kinds of primary and grammar schools and four secondary schools. There are also special schools of which normal schools and commercial schools are the most conspicuous examples. Three of the four lower schools are alike in the length of the course and in the plan of instruction, and are sometimes spoken of collectively as Volksschulen (peoples' schools). They are known as the Bezirkschule, the Burgerschule and the Higher Burgerschule. They are alike open to boys and girls and are managed and chiefly supported by the state, the only apparent difference being in the amount of the tuition required at even these city schools. In Leipzig it is as follows:

Per year Bezirkschule	Marks	4.80
Burgerschule	"	18.00
Higher Burgerschule	"	36.00

This difference in cost gives the schools a social and in a measure

* Those desiring to go more thoroughly into the question of German School organization will find much material in the Special Reports on Educational Subjects, edited for the British Government by Michael Sadler, and in a similar series edited by the United States Commissioner of Education, W. T. Harris. No. 9 of the British Series deals with German Secondary education. In the American series Dr. F. E. Bolton has written a volume on "The Secondary School System of Germany."

an intellectual stratification. The Bezirkschule is made up of the children of the poorest class in an industrial community having compulsory education. The other schools are filled by those who can afford to pay the higher fees. While the three schools have the same plan of instruction, the cheaper schools do not pay the teachers as well, the children come from the less intellectual homes of the community and do not accomplish as much as those going from better home influences to the more coveted Higher Burgerschule.*

The course of instruction in the Volksschulen (peoples' schools) gives a general elementary education, a large amount of "religion" and one or sometimes two foreign languages, French, or French and English. The boy who has completed the eight years of the Burgerschule finds it impossible to go on and prepare for the university because he lacks the Latin or Greek that are being taught in the Gymnasia, the avenue to the university. Consequently all those students in the Volksschulen who have prospect of a higher education enter the secondary school at the end of the fourth year of the Volksschule.

The secondary schools are of three kinds, the Gymnasium, the Real Gymnasium and Realschule. They are all for boys only, receiving them at the end of the fourth year in the lower schools, and in the case of the first two offering a nine-year course. The German shool par excellence is the Gymnasium, *i. e.*, the classical gymnasium, giving much Latin and Greek, and some French and English, and admitting to all branches of the university. The Real Gymnasium is a compromise, leaving out Greek, putting more emphasis on modern languages and science, and admitting to all branches of the university except theology and law. The Realschule gives no classics, but has much French and English; and lays particular emphasis on science. It has only a six-year course and does not admit to the university. It is a creation to give a partial secondary education to the student who has no hope of or desire for the university'† and who does not wish to study the

* This differentiation of schools is impossible in the country districts where the village school with one or two teachers gives, as nearly as possible, the same eight years' course that is given in the city Volksschulen.

† The position of the classics in German education is weakening under the attacks of the reformers, who would substitute modern languages and science. The reformers have already established the Realschule and are working for an Ober (Upper) Realschule which shall parallel the classic gymnasium and admit to the university.

classics. It bears considerable resemblance to the girls' high school, which begins at the beginning and gives a ten-year course, running practically parallel to the Volksschulen and, like the Realschule, going two years farther. This school employs well-paid and well-trained teachers, requires a tuition fee of 120 marks a year, and offers a somewhat "select" education during the elementary and a part of secondary education. It forms, indeed, the chief part of secondary education for girls in Germany, the only other governmental provision being half a dozen classical and Real Gymnasia where a four-and-one-half-year course is supposed to give the graduate of the girls' high school the same training that the boys receive in their gymnasia.

In addition to the general culture schools there are trade schools and commercial schools of many grades, some of them night schools, some of them day schools. They are usually municipal, and therefore miss the systematizing that the general culture schools receive through the central organization, presided over by the Minister of Culture and Public Instruction. The commercial schools are apparently planned to take the students who are left over. There is great irregularity of entrance, the boys coming from the various classes of the primary and secondary schools. The aim is practically the same as that of the common American "business college," but the student usually has business correspondence in several languages, and the course is broadened by instruction in commercial geography and commercial history.

The normal schools take the student at the end of the Volksschule course and in six years prepare for teaching in the elementary schools. They also offer a roundabout avenue along which the Burgerschule boy may make his way into the university where he is allowed to take a special course, known as the course in pedagogy.

With all of her state and city schools, Germany has many private schools, but they cannot be discussed within the limits of this paper.

The accompanying table (pp. 424–5) gives a view of the subject matter and method of arrangement of the geography taught in the seven general culture schools referred to above. The titles in the column representing the Volksschulen are unfortunately too brief because those schools issue no catalogues. The arrangement as given is taken from the program of the second Higher Burgerschule in Leipzig and may be considered as typical of the Volksschulen generally. The more amply described course of the girls' high schoo

gives particulars for the first two years that may be accepted as a full definition for Heimatkunde.* The courses given for the three intermediate boys' schools are copied from annual catalogues. Each column is copied from a particular school, but examination shows that the courses in other schools of the same class have a resemblance that approaches identity. The increased space used in describing the courses in the different secondary schools may be taken as a rough indicator of the interest in the subject. The teachers in the classical Gymnasium tell me when I visit their classes, "Well, if you are interested in geography, you ought to go to the Real Gymnasia or the Realschulen; we don't make a specialty of it here." Yet the course shows that even these schools provide for a good course in geography. It must be remembered that all students in the secondary schools who have had the first four years of the Volksschulen, begin again with a review of Heimatkunde. By following through the plan of any school, one will see how the course is arranged to begin with the local concrete things that surround the child, then gradually to widen the field, then review it all and go deeper, then widen it again and fix it in the memory by drill and further review. The student never gets the idea that he has "finished" a certain book or part of the world, and the correlation of studies tends to further emphasize this point.

The text-books are rarely used, and when they are, it is in the literal sense of the word text. I have seen a lesson developed from a paragraph and sometimes from a sentence. In the main the teacher is the text-book and in the lower grades no book whatever is used except an atlas, which each student always has. It seems to be the universal custom in Germany to bind maps in one volume and description in another, whether it be the pamphlet accompanying a 25-cent atlas or the two-volume discussion that accompanies one of the magnificent big hand atlases that lie on the desk of the university professor. One of the leading teachers of geography said to me, "Yes, there are many school geographies, but none of them is very satisfactory, and so we select our own facts." The method offers possibilities of grand work with the teacher of high intelligence and efficiency, but I found that the converse was also true. In the later years of the course the students usually have some small book that merely serves as an outline. For example, in the girls' high school, the classes from 5–1 use Daniel's "Leitfaden

* Common English translation is "home geography."

Courses in Geography in the Elementary and Secondary Schools of Leipzig.

Year of the School.	Volksschulen or People's Schools.	Real Gymnasium.	Gymnasium.	Real Schule.	Higher School for Girls.
	Children Begin School Here.	Boys have had Four Years in the Primary Schools		Boys have had Four Years in the Primary Schools.	Girls Begin School Here.
I		*2 hrs.* Development of ideas concerning local geography. Saxony in detail, survey of Germany and superficial view of Europe and the world.	*1 hr.* Geographical ideas. Elements of globe study. Heimatkunde.	*2 hrs.* Review of Heimatkunde. Thorough treatment of the Kingdom of Saxony. Survey of Germany. Europe and the world.	
II		*2 hrs.* Widening of geographical ideas. European countries other than Germany. Practice in map drawing.	*2 hrs.* Political and physical geography of Germany. Survey of the other countries of Europe.	*2 hrs.* Mathematical and astronomical geography; horizon and compass; motions of the sun, moon and earth. Latitude and longitude. Political geography of European countries other than Germany. Practice in map drawing.	*1 hr* Heimatkunde. The (students') birthplace. The place of residence. Town and village with their inhabitants. Leipzig and nearer environs. Chief streets and squares, especially of the inner city after the plan of Leipzig. The easiest geographical preliminaries.
III	*2 hrs.* Heimatkunde.	*2 hrs.* The continents other than Europe. Important points in physical geography.	*2 hrs.* The continents other than Europe.	*2 hrs.* Astronomical and Mathematical geography; form and movements of the earth latitude and longitude, calendar, phases of the moon, eclipses. Political geography, the continents other than Europe.	*1 hr.* Heimatkunde of the wider environs of Leipzig in connection with the official wall map of Leipzig. Questions on observations.
IV	*2 hrs.* Vaterlandkunde (Geography of Saxony).	*2 hrs.* Political and physical geography of Germany.	*2 hrs* (in winter semester). Germany.	*2 hrs.* Political geography and physical geography of middle Europe Astronomical geography, the apparent movements of the heavenly bodies. Map drawing.	*1 hr.* Geography of Saxony.

COURSES IN GEOGRAPHY IN THE ELEMENTARY AND SECONDARY SCHOOLS OF LEIPZIG.

V	*2 hrs.* Geography of Germany	*2 hrs.* Political and physical geography of European countries other than Germany.	*2 hrs* (in summer semester). Physical geography and elements of mathematical geography.	*2 hrs* Mathematical and astronomical geography; location and movements of the earth; the Julian and Gregorian calendars; the moon; the planets. Political geography: the European countries other than Germany. Map drawing.	*2 hrs.* Geography of the German Empire. Survey of Europe.
VI	*2 hrs.* Geography of European countries other than Germany.	*2 hrs.* General geography and review of the whole field of geography.		*2 hrs.* Astronomical and mathematical geography The horizon, shape and size of the earth, rotation and revolution, comparison of time, solar system. Political Geography of the continents other than Europe (after a review of physical relations) with reference to colonies and trade. Review of Europe.	*2 hrs.* Principles of general geography. Survey of the five continents with Europe as a basis. Review of Germany.
VII	*2 hrs.* The continent other than Europe.				*2 hrs.* The earth as a planet. Europe with especial attention to Germany.
VIII	*2 hrs.* General review.				*2 hrs.* Selections from mathematical geography. The geography of America. Europe reviewed and extended.
IX					*2 hrs.* Selections from mathematical geography. Geography of Asia, Africa and Australia. Review of America.
X					*2 hrs.* Mathematical and physical geography. Germany.
	End of school.	End of school.	End of school.	End of school.	End of school.

der Geographie," a little book costing a mark, and containing in 224 pages a discussion of the political geography of the world with touches of history and economics and physical geography. This book is quite popular and is typical of a class. Similar books are usually used in the last two or three years of geography work in the Gymnasia. In the Realschulen the books sometimes contain more economic data and the courses are often tinged with commercial geography, the atlases sometimes being the same as those to be found in commercial schools.

The map equipment of the classrooms is usually good and the relief maps, physical maps, etc., of Germany and Europe are exceptionally fine. The teachers often showed great facility in drawing maps upon the blackboard and a favorite device is to have the students name and tell something about the cities, rivers and mountains as they are worked into the developing map. A part of every teacher's equipment is a set of colored crayons, and map drawing by the students is a strong point in nearly all courses of instruction, and much care is taken to see that children really understand what the maps mean—something that can rarely be attained without practice and intelligent instruction in map drawing.

Large colored pictures of geographic subjects form a very common part of the school equipment. The manufacturers of school appliances offer long lists of them and the teacher is at liberty to take the pictures to class just as he does the wall map. In actual practice I found them in use in about one class in seven of those I visited, and they were used and explained in a very instructive manner.

Schools also have collections of interesting objects for class use. For example, I have seen the Australian boomerang in class, along with a picture of a group of natives engaged in their domestic affairs. This gave an opportunity for an account of the savages' mode of life, food supply, weapons, the animals he hunted and the peculiar Australian vegetation in the background.

The children are sometimes encouraged to bring to class such pictures as they may find, bearing upon their lessons.

The effort to vivify the student's knowledge leads to the adoption of a regular system of sight-seeing. In the spring and summer it is a common sight to see long files of school children accompanied by one or two teachers who are taking them down to the river, or to the park to show them the big forest trees, the hay-meadow,

the hay-makers, or to the outskirts of the city to see the rye and potato fields, the cherry trees by the roadside, the fruit orchards or factories that they have heard about in geography classes. In vacation these trips are often extended to railroad journeys lasting days, and give information at first hand concerning hills, rivers, mountains, forests, distant cities and the products of different sections. Objects of historical interest are included in these excursions, nor is the zoölogical garden neglected.

The teachers in the secondary and Volksschulen are almost universally men, except a few teachers of needlework and girls gymnastics.* The requirements in the classics make it practically imperative that the Gymnasium teachers have university training, and the Doctors' title is very common among them. The teachers for the country schools and the city Volksschulen are usually trained in the normal schools. In one of the best Leipzig higher Burgerschulen four teachers out of twenty-four had studied in the university. A teacher in one of the Burgerschulen in the same city estimated the proportion of university-trained teachers in such schools as ten per cent or less.

The general method of teaching may perhaps be best illustrated by giving notes of visits to classes.

A Leipzig higher Burgerschule, third class from the beginning, girls averaging nine and one half years, beginners in geography—Heimatkunde. The teacher, a bearded and kindly man of forty-five or fifty, followed the method of alternately telling them the facts and then quizzing different members of the class to fix the knowledge. Each child had before her an excellent map of Leipzig and environs on the scale of four or five inches to the mile and giving all the streets, car lines and railways, showing in colors the various suburbs, and distinguishing the woods from the open lawns of the parks and squares. On the other side of the same sheet was a map on the scale of one-half inch to the mile, giving a section of the surrounding country about 25 miles square. On the outside of the pasteboard cover was a detail map, showing one square kilometer in the center of the town. The larger scale map was divided into squares and was accompanied with an alphabetical list of streets and a finder. A corresponding but larger map hung on the wall, and the children pointed out the places under consideration during the lesson. They were drilled on the points of the

* For statistics on this question see the works referred to on p. 420.

compass on the map and in the room itself; on the different kinds of landscape surrounding the city; the kinds of shade trees in the neighboring woods; the haymaking in the big meadow in the park; the season, methods of making, and use of the hay; the rolling farm lands and the different crops they produced, and the various streams in the vicinity. Some of the children appeared to recite from blind memory, but the summer field excursions were expected to remedy that defect.

A Leipzig classical gymnasium, lowest class, boys of ten who, it will be remembered, had had the first two years of geography in the Volksschule. The teacher, a man of forty, showed the possibilities of widening the instruction when unhampered by a text-book. The lesson was ostensibly on Saxony. The teacher told the boys but little, but there seemed to be a premium on the bringing of fresh information into class. The boy who could name and point out all the kingdoms, principalities, etc., that compose the German Empire was something of a hero, and the boy reciting was much disappointed that he could only go through with twelve of the list. Another could point out France, another Russia, others the important rivers of Germany, etc. When suitable, there was development, repetition and drill on the information that some boy had given. The teacher kept it profitable by guiding the subjects. One boy came from a granite quarry town, and knew where the stone in the big front steps came from; then came a discussion of the location, source of supply for Leipzig of building stone and the uses, cost and qualities of various kinds. Several times during the lesson something that was in the building or the city was traced back to its origin and geographical connection in Saxony. The lesson was striking for the continued interest, alert attention and perfect but spontaneous discipline. The teacher remarked later that lots of men knew a great deal more than they could teach to boys.

Another lesson in the same Gymnasium showed another aspect of the German method, and illustrates the German's love for science for its own sake. The teacher, a brilliant young man of thirty, came of a scholarly family, was a doctor of philosophy and had studied scientific geography deeply. The students were in Quarta class, third year in the Gymnasium; the lesson was on North America, and the instructor's scientific geography showed itself. The students were asked to name the two great mountain systems, the Mississippi, Missouri and Mackenzie Rivers (omitting the Great

Lakes) and then the greater part of the period was devoted to the region north of the limit of habitation. The boys named and pointed out (thereby indicating a previous lesson on the same) the barren, treeless, uninhabited and unexplored peninsulas and islands north of Hudson Bay. The magnetic pole was briefly mentioned. A polar map was then hung up and interior Greenland was well described, an account of Nansen's trip across Greenland was given, and arctic geography and exploration were thoroughly expounded by the teacher, and drilled into the boys. No reference was made to questions of economic import or to the life of any of the North American peoples, yet in that year, in two hours a week, a total of not over seventy-five lessons, including reviews and examinations, those boys were going to begin and end their study of North and South America, Asia, Africa, Australia and the Pacific Islands.

A number of other recitations might be described in detail showing minor variations, but the above illustrate the theory on which the work is based and the methods generally in use. On the whole, the work appears to be well done when compared to any other with which the writer is familiar either in England or the United States. The freedom from text-book which gives the teacher the possibility of widened instruction, has also its possibilities in the other direction, as for example, when it allows a corpulent man of fifty or fifty-five years to give to girls of twelve and thirteen the contents of his text-book in the form of a monotonous lecture, and only preserve the form of a class by asking an unimportant question once in four or five minutes.

In the classes visited by the writer, a considerable portion of the boys' teachers showed the influence of their service in the army. The discipline was sometimes stiff, mechanical, military and decidedly unindividual. In some cases the teacher gave, by the noise he made, the impression that he was handling a bunch of raw recruits on the drill ground. Such instruction might produce learning, but scarcely culture or refinement.

The correlation of studies receives much attention in Germany, and geography offers great opportunity in that direction. It is quite common to emphasize its relation to natural science in the lower classes and to history in the higher classes. Accordingly, the natural science teacher often has the geography in the beginning, and it goes over later to the history teacher. I have been told by the principal of one of the Volksschulen that he has ever before

him the ideal of binding into one connected mass of knowledege geography, history and industry and by the liberal use of comparison to make the courses much wider than they appear to be.

Germany is self-centered. The courses in history begin and end with Germany, and give very little attention to any other country. The method of instruction seems to savor strongly of the imperial idea, with militant Germany as a unified and central figure. History is a tool to excite patriotism, and geography, by its great emphasis on Germany, is in some measure her sister. One result is a surprising ignorance of foreign countries, and America is no exception. It is not uncommon for a person knowing that you speak English to ask if you are English or American, and then "are you a North American or a South American?"

It is reasonable to expect that the German's ignorance of other countries will diminish as a result of the broad instruction now being given in the universities, and of the German's new-found interest in foreign commerce and in colonial questions.

GEOGRAPHY CURRENT

CARTOGRAPHY

The United States Geological Survey has just issued a very valuable chart on the anthracite coal industry. On a sheet 20 x 33 inches is given a map of the anthracite coal field, with its divisions, northern, eastern middle, western middle and southern; a table in large and legible type showing annual output from 1820 of each division and of the totals. A very legible graphic chart illustrates the output as shown in the tables. The chart is issued by David T. Day, Chief of Division of Mining and Mineral Resources, and was compiled by William W. Ruley, Chief of Bureau of Anthracite Coal Statistics, Philadelphia. The chart is large enough to be legible to an ordinary class, and will be a valuable addition to the equipment in geography. J. P. G.

HYDROGRAPHY

Drainage Canals in the Province of Buenos Aires.—A large portion of the fertile Province of Buenos Aires is subject to periodical inundations resulting from the heavy rains of the winter season and causing great damage to the farm and pasture lands. According to a

communication from the Belgian Legation at Buenos Aires, for the last ten years the government of the Province has fostered the plan of remedying this situation by building a series of canals to carry the water to the sea, utilizing, so far as possible, the existing rivers. —*Bull. Bur. Am. Rep.*, February, 1902.

PHYTOGEOGRAPHY

Phytogeographic Subdivisions of North America.—Professor Engler, the indefatigable German botanist, has published an important paper on the phytogeographic subdivisions of North America. His chief purpose has been to outline his scheme for a North American botanical garden at Berlin. Already this garden contains a vast number of our plant forms, arranged according to their distribution. His chief divisions are Arctic, Subarctic, Atlantic and Pacific. These divisions are in turn subdivided into provinces. For example, Atlantic America contains four provinces: Lake, Mississippi-Alleghany, South Atlantic and Prairie. The provinces are split up into zones, and the zones into their respective formations or societies. Each of the formations is fully described, and the characteristic species mentioned. The work as a whole is an exceedingly faithful presentation of our phytogeography, although largely a compilation.

H. C. COWLES.

Coastal Vegetation of Virginia and North Carolina.—Reference has been made in these columns to the work of Professor Harshberger on the New Jersey coast. T. H. Kearney has carried on similar investigations farther south, and his results have been published by the Department of Agriculture. In his first paper a study was made of Ocracoke Island, off the coast of North Carolina. Here there is found the greatest humidity and rainfall in the eastern United States, and one might well expect (and the expectation is realized) an abundance of far southern plants. In place of the dominant *Cakile* and sand reed of the more northern beaches and dunes, *Croton* and the sea oats appear to rule. Groves of live oak with the southern long moss (*Tillandsia*) form a strong contrast to the woods on northern dunes. However, many species are common here as there; seaside spurge, saltwort, bayberry, red cedar and poison ivy are found on the southern coasts and also on Cape Cod. The salt marshes, dominated by *Salicornia* and *Spartina*, most resemble the marshes of New England. Some fresh-water

species mingle with those of salt water; this is probably due to the encroachment of fresh conditions, though Kearney thinks that the mingling of rain and salt spray accounts for the phenomenon.

Kearney's second paper is an elegantly illustrated report on the botany of Dismal Swamp. The maritime plant formations are discussed in addition to those of the swamp proper. The salt marshes very closely resemble those farther north, as do the dunes, though the sea oats of the southern dunes mingle with the sand reed. Such plants as the button bush, groundsel tree and long-leaved willow are cited to indicate the amount of moisture in the sand; doubtless they are also relicts of a marsh upon which the dune has encroached. On the old dunes the southern live oak occurs, but *Pinus Tæda* is the dominant tree. In the forested regions, pines occupy the poorer soil, while the sweet gum, beech and various oaks occupy richer lands. Two swamp types are distinguished: (1) The black gum or dark swamp; here one finds the cypress and red maple, as well as the gum, and the soil is always very wet. (2) The white cedar (*Chamæcyparis*) dominates in the juniper or light swamp; here the soil is drier though more acid. The Dismal Swamp plant societies, Kearney thinks, are determined chiefly by drainage differences, a conclusion which seems highly probable. Many southern species reach here their farthest northern limit.

H. C. COWLES.

ECONOMIC GEOGRAPHY

Sugar Statistics.—Some interesting figures quoted from the monograph of the Treasury Bureau of Statistics, in *Bradstreet's* of March 29, show the gradually increasing importance of beet sugar in the world's sugar crop.

Years.	Cane Sugar, tons.	Beet Sugar, tons.	Beet Sugar per cent.
1840	1,100,000	50,000	4.35
1850	1,200,000	200,000	14.29
1860	1,510,000	389,000	20.23
1870	1,585,000	831,000	34.40
1880	1,852,000	1,402,000	43.08
1890	2,069,000	3,633,000	63.70
1900	2,850,000	5,950,000	67.71

E. D. J.

The Walnut Industry in Southern California.—In October some of the schools in southern California have what is termed the

"walnut vacation." As a general thing this lasts for two weeks. It is not always possible to secure workmen to handle the crop and the children are of so much help in picking up the nuts that school is dismissed for a time.

The roots of the walnut tree run for long distances, and the trees are usually planted forty feet apart. Both the hard and the soft-shell varieties are raised, but the soft-shell is the more common, as it brings the higher price.

When the nuts are ready to be harvested, the trees are shaken and then the individual limbs are shaken by means of long poles, to the ends of which wire hooks are attached. Finally, men beat the limbs to detach those which have not fallen.

The pickers follow the shakers. They gather the nuts into pails and baskets and empty them into sacks holding about one hundred pounds each. Usually the fall separates the shuck from the nut, but where this has not been done, the picker must attend to it.

The sacks are hauled from the grove to the washer and grader. This is a cylindrical machine made of wire. It is made to revolve in a tank filled with water, by means of horse-power. The sacks of nuts are emptied into one end of the cylinder and washed and graded at the same time. The smaller nuts pass through the meshes in the cylinder and the larger ones are thrown out by using a lever for the purpose.

The nuts are next spread out on trays. The trays are piled one upon another and put under a large box made of tarred paper. A small quantity of sulphur is burned in the box and the fumes whiten the shells of the nuts. This is called fumigating. Instead of fumigating, the nuts are often dipped into a preparation which has the same effect. This process is the cheaper of the two.

The nuts must now be dried, and for this purpose the trays are spread out on frames, usually two or three feet from the ground. The trays are placed on a tram-car and the workmen push it to the part of the yard where the trays are to be spread. The drying requires from five days to two weeks, according to weather conditions.

When the nuts are thoroughly dried, they are again sacked, marked and are ready to ship.

Whittier, Fullerton and Rivera are in productive walnut sections. The city of Pasadena is now an extensive walnut producer. On its sewer-farm, a few miles to the southeast, there is a grove of sixty acres in full bearing and an additional thirty acres of

young trees. The crop for this year on this farm is estimated at thirty-five thousand pounds, which, at present prices, will bring $3,500. J. F. C.

Gold Production of the World. — The gold output of the chief producing regions of the world in 1891 and 1900 is given in *Bradstreet's* of March 29, 1902, as follows:

	1891.	1900.
Australasia	£ 6,288,238	£15,135,206
Africa	3,017,015	15,753,768
America	9,133,499	25,931,729
Europe	5,329,405	5,692,451
Asia	1,683,719	3,790,270
Total	£25,541,876	£66,303,424

Even these figures do not show the actual progress, as the 1900 record of 12,370,054 ounces which is to be compared with the 5,991,877 ounces of 1891 was affected by the closing of the Rand mines, and a more accurate comparison would be with 1899, when the yield was 14,900,145 ounces. E. D. J.

Current Articles on Commerce and Industry.—Accidents in Coal Mines, *Engineering and Mining Journal*, October 25.

Africa, Commercial (Ill.), *The World To-Day*, November.

Americans in the Raw (Ill.), *World's Work*, October.

Apple Crop, *American Agriculturist*, October 25.

China, Plows in (Ill.), *Consular Report*, October.

Coal Strike (Report of Hon. C. D. Wright), *Bulletin of Department of Labor*, November.

Coal: Nations with Small Supply, *Bradstreet's*, October 4.

Coal, Substitutes for, in Heating and Cooking (Ill.), *Scientific American*, October 25.

Coal Storage (Ill.), *Scientific American*, October 18.

Cotton Goods, U. S. Export of, *Textile Record*, October.

Cotton, Egyptian, *Textile Record*, October.

Dutch East Indies, Gold in (map), *Engineering and Mining Journal*, October 4.

Europe versus America (Carnegie), *World's Work*, November.

Fisheries, Saving, of our Inland Seas (Ill.), *World's Work*, November.

Food Adulterations, *Commercial Bulletin and North West Trade*, October 11.

Fuels, The World's, *Bulletin of International Bureau of American Republics,* September.

Irrigation Canal, The Arizona (Ill.), *The World To-Day,* November.

London, Rebuilding of (Ill.), *World's Work,* November.

Maine's Wood Novelty Mills, *Scientific American,* October 25.

Mexican Silver Ore Reduction (Ill.), *Engineering and Mining Journal,* October 18.

Minnesota (Ill.), *Harper's Weekly,* November 1.

Peat-fuel, Electrical Manufacture of (Ill.), *Scientific American,* October 11.

Plate Glass Making, *Paint, Oil and Drug Review,* October 22 and October 29.

Potter's Wheel, Evolution of (Ill.), *Clay Worker,* October.

Rubber Industry in South America (Ill.), *Harper's Weekly,* November 1.

Salt Making (Ill.), *Harper's Weekly,* November 1.

Sault Ste. Marie Water Power Canal (Ill.), *Scientific American,* November 1. Also article of same title in *The World To-Day,* November.

Shipbuilding, Twentieth Century Types (Ill.), *Review of Reviews,* October.

Siberia (Ill.), *Harper's Weekly,* October 18.

Silk (continued), *Textile Record,* October.

South African Coal Fields, *Bradstreet's,* October 11.

Standard Oil Company, History of, I. (Ill.), *McClure's,* November.

Steamers, Ocean (Ill.), *World's Work,* October.

Texas, Industries and Resources of, *Hide and Leather,* October 11.

Tin Plate Manufacture (Ill.), *Scientific American,* October 4 and November 1.

Turkey Mineral Resources, II., Oil and Asphalt, *Engineering and Mining Journal,* October 4.

United States, Territorial and Commercial Expansion, 1800–1900 (with maps), *Monthly Summary of Commerce and Finance,* August. E. D. J.

GEOGRAPHIC LITERATURE

BOOK REVIEWS

Lives of the Hunted.—Ernest Thompson-Seton. 8 x 5½ in. New York, Charles Scribner's Sons. 1901. Pp. 361, 30 illustrations with many marginal drawings.

In his *Lives of the Hunted*, Mr. Thompson-Seton has assembled the stories of five quadrupeds, and three birds. Some of these tales are of the author's best. Krag the Kootenay Ram, and Tito the Coyote that Learned How, are scarcely excelled in the literature of animals.

In all our schools the teachers are called on to do more or less nature study. Here is refined nature study—true wild animal life—the unending tragedy and pathos of the struggle for existence told in fascinating style, and embellished with many drawings from the author-artist's own pencil and brush.

Mr. Thompson-Seton is a trained naturalist and he ranks, perhaps, equally high as an animal painter and delineator, but best of all he is an artist in the use of words, and his strong sympathies with the wild animals is given splendid setting in these stories.

In the jungle tales of Mr. Kipling, a keen student of men saddles the thoughts and actions of men on to the dumb animals to gain a startling or romantic setting. Mr. Thompson-Seton is a student of animals, and tells their life history simply. If he does it in a romantic way, and with sentiment, it is because the situations the animals face have these qualities. Judgment and reason are universal, and the syllogism holds whether made by the mountain sheep or man.

It is a great pleasure to recommend these stories, which should be in every elementary school in all our broad land, and which should prove equally fascinating and instructive to children and parents. J. P. G.

I., **Ways of Wood Folk;** II., **Wilderness Ways;** III., **Secrets of the Woods.**—William J. Long. 7¼ x 5¼. Boston, Ginn & Co., 1901. Vol. I., pp. xii + 206; illustrations, 18; price, 50c.; Vol. II., pp. x + 156; ill. 14; price, 60c.. Vol. III., pages x + 186; ill., 20; price, 60c.

Geography is the study of the earth and its inhabitants. In the good old definition there has been little thought of including the wild life of the forest, though it is true, a list of the larger animals is usually given, like a spelling lesson in paragraphs devoted to a region. But if one wants a real personal social acquaintance with the animal life of our great northern wilds, next to getting it at first hand is to learn it through such books as these of Mr. Long. Here is a kindly personal sympathy, and a wealth of keen observation, which presents the inner social life of the wild animals in a straightforward natural way, making us acquainted with them individually. There is not a false note here. These studies are not human frailties and virtues saddled on to animal characters for a romantic setting. "They are studies of animals pure and simple," and "any animal is interesting enough as an animal, and has character

enough of it own, without borrowing anything from man." These little books are the ideal natural history, authentic, refined and vitalized, and most excellent collateral reading in elementary nature study and geography.

J. P. G.

Tea, its History and its Mystery.—By Joseph M. Walsh. 7¼ x 4¾ in. Philadelphia, Henry T. Coates & Co. Pp. 265, 6 illustrations.

Tea Blending as a Fine Art. Author and publisher ditto. Pp. 151, 10 illustrations.

Coffee, its History, Classification and Description. Author and publisher ditto. Pp. 310, 10 illustrations.

These volumes contain chapters on early history and distribution, botanical characteristics, cultivation and preparation, commercial clasification, adulteration and detection, chemical medical and dietetic qualities, and the world's production and consumption.

Down Historic Waterways. Six hundred miles of canoeing upon Illinois and Wisconsin Rivers.—By Reuben Gold Thwaites. 7½ x 5 in. Chicago, A. C. McClurg & Co., 1902. Pp. 300, 8 full page illustrations.

Here is an interesting volume in which three canoe trips are described. Mingled with a keen appreciation of nature, are observations on the people, and historical reminiscences of the old French voyageurs, and the later pioneer days of Wisconsin and Illinois, of the Black Hawk War and the disappearance of the red man.

It is a book of keen local interest, and will be read with pleasure and profit in all the region of the three rivers described, the Rock, the Wisconsin and the Fox, and it deserves a much wider audience.

J. P. G.

SOCIETIES AND MUSEUMS.

The Field Columbian Museum has recently enlarged and reinstalled its collection of relief maps, so that they now occupy two large halls comprising 2,800 feet of floor space. Perhaps no other museum in the world has so much space devoted to an exhibit of this character. Over fifty carefully executed relief maps are thus displayed, besides globes, wall maps and photographs. So far as possible the maps are set upon shelves extending around the walls of the room at a height favorable to their close examination. Others rest upon specially designed metal easels and the remainder of the floor space is occupied by tables upon which some maps are exhibited and in drawers underneath others such as the series of topographic maps of the U. S. Geological Survey are placed so as to be available for examination if desired. The aim in installation

XUM

has been to secure the best light possible and to arrange the maps so that they can be easily examined. The models exhibited include many well known ones, such as that of the United States modeled upon a section of a globe 16½ feet in diameter, a similar one showing the area covered by ice in the glacial period, reliefs of the States of Missouri, Kentucky, New Jersey, Massachusetts and Connecticut, two reliefs of Palestine, reliefs of the Henry Mountains, Mount Shasta, the Chattanooga District, Yosemite Valley, Caucasus Mountains, and France, Heim's series of ideal reliefs, some of the Harvard models and many others. Among the reliefs recently added are Siebenthal's series illustrating the recession of Lake Chicago, a relief of Niagara Falls and vicinity, of the Hawaiian Islands and of Porto Rico.

The collection in its enlarged form is already proving of considerable use to Chicago teachers for purposes of instruction and is a means of inculcating geographical knowledge and interest among all visitors. O. C. F.

The Geographic Society of Philadelphia opened the session for the year 1902–03 on Wednesday evening, November 5th, at Witherspoon Hall. In accordance with the Charter and By-Laws, the first meeting of the year is devoted to the annual address by the President of the Society. The investigation of the catastrophe of St. Pierre and the volcanic disturbances in the Island of Martinique, undertaken by Professor Angelo Heilprin during the past summer, have been followed with interest, not only by members of the Society, but by the general public. The announcement that an account of his experiences in the vicinity of Mont Pelee would be the subject of President Heilprin's address, was sufficient to fill the hall to its utmost capacity. With numerous and remarkably clear photographs, and with a graphic narrative, which lost nothing by its marked simplicity and modesty, the story of this great convulsion of nature was told to the audience.

Among the speakers who are expected to address the Society during the present season are Professor Herman V. Hilprecht of the University of Pennsylvania and Lieutenant Robert E. Peary. It will be the endeavor of the Society, so far as possible, to make the reports of recent research and investigation the topics for consideration.

FRANK B. GREENE,
Secretary.